Determining the spatial pattern of tree stock and the need for the first thinning with area based approach of airborne laser scanning

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Laser scanning as a forest inventory method has provided good results for estimation of forest stand characteristics. Using laser scanning to determine the spatial pattern of tree stock without expensive field work could open new possibilities to use spatial models. Also determining the need and proper timing for forest management operations could improve and intensify forest planning. The aim of this study was to identify laser variables from ALS (airborne laser scanning) data, which could help to determine spatial pattern of tree stock and need for first thinning of microstands and classify them based on that information.

The field data consisted of 28 microstands measured in Janakkala in summer 2009. The ALS data was acquired in 2007 and its pulse density was 0,62 hits per square meter. The need for first thinning and the spatial pattern of trees was determined for microstands based on field data and then classified into four classes: 1) need for thinning, clustered, 2) need for thinning, not clustered, 3) no need for thinning, clustered and 4) no need for thinning, not clustered. In data analysis we used discriminant analysis to create models, which classified microstands to the corresponding classes as based on field data. Additionally, models were built solely based on the need for thinning and the spatial pattern of trees. The predictors in the models were laser point variables based on the canopy height and density distributions, texture features by Haralicks et al. (1973) and landscape metrics, the last two calculated from classified canopy height models. The goodness of models was tested by comparing their classification with corresponding classification based on field data.

The classification of the spatial pattern of tree stock and the need for thinning succeed well, with overall rate of accuracy being 0.86 and kappa-value 0.81. Similarly, also the classification based on solely the spatial pattern of tree stock succeed well, with accuracy 0.89 and kappa-value 0.76. Classification based on solely the need for thinning succeeded even better, with the overall rate of accuracy being 0.96 and kappa-value 0.93. It was found difficult to identify the spatial pattern of tree stock of microstands, which were clustered and very dense, because of their small sized canopy gaps.

In this study we got promising results on the identification of the spatial pattern of tree stock and the need for first thinning with low density ALS data. We found both new laser variables and those based on the canopy height and density distributions. The used approach should be more researched, however, to generalize the results and especially to find more new ALS based predictors for identifying spatial tree pattern.

Key words: Laser scanning, spatial pattern of trees, first thinning, texture, landscape metrics